

## RESEARCH ARTICLE

**The Offer of Advanced Imaging Techniques Leads to Higher Acceptance Rates for Screening Colonoscopy - a Prospective Study****Heinz Albrecht<sup>1\*</sup>, Julia Gallitz<sup>1\*</sup>, Robert Hable<sup>2</sup>, Michael Vieth<sup>3</sup>, Gian Eugenio Tontini<sup>1,4</sup>, Markus Friedrich Neurath<sup>1</sup>, Jürgen Ferdinand Riemann<sup>5</sup>, Helmut Neumann<sup>1</sup>****Abstract**

**Background:** Colonoscopy plays a fundamental role in early diagnosis and management of colorectal cancer and requires public and professional acceptance to ensure the ongoing success of screening programs. The aim of the study was to prospectively assess whether patient acceptance rates to undergo screening colonoscopy could be improved by the offer of advanced imaging techniques. **Materials and Methods:** Overall, 372 randomly selected patients were prospectively included. A standardized questionnaire was developed that inquired of the patients their knowledge regarding advanced imaging techniques. Second, several media campaigns and information events were organized reporting about advanced imaging techniques, followed by repeated evaluation. After one year the evaluation ended. **Results:** At baseline, 64% of the patients declared that they had no knowledge about new endoscopic methods. After twelve months the overall grade of information increased significantly from 14% at baseline to 34%. The percentage of patients who decided to undergo colonoscopy because of the offer of new imaging methods also increased significantly from 12% at baseline to 42% after 12 months. **Conclusions:** Patients were highly interested in the offer of advanced imaging techniques. Knowledge about these techniques could relatively easy be provided using local media campaigns. The offer of advanced imaging techniques leads to higher acceptance rates for screening colonoscopies.

**Keywords:** Advanced imaging techniques - screening colonoscopy - acceptance rates - Germany

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**Introduction**

Colorectal cancer is one of the most commonly diagnosed cancers with an incidence rate of approximately 36.8 per 100.000 in women and 57.8 in men. Worldwide, colorectal cancer is the third most common cancer and the fourth leading cause of death from cancer (Hagggar et al., 2009; Ferlay et al., 2010; Ferlay et al., 2013). In 2008, across the world a number of 1.2 million new cases of colorectal cancer and a number of 608.700 deaths caused by it had been recorded (Jemal et al., 2011). Together with Australia, New Zealand and North America, Europe is one of the regions with the highest incidence rates (Jemal et al., 2011). This suggests that colorectal cancer is more prevalent in highly developed countries. Various risk factors leading to the development of colorectal cancer have been identified including alimentary habits like excessive meat consumption, lack of physical activity, obesity, and excessive consumption of tobacco and alcohol

(Durko et al., 2014). The mean age of patients diagnosed with colorectal cancer is 68 years. The incidence rate begins to rise steeply after the age of 50. That is why 90% of all colorectal cancers are diagnosed in patients over 50 years of age (Labianca et al., 2005). The five-year survival rate is highly dependent on the stage of the disease. When diagnosed at an early stage the rate is 80-90%, whereas it drops to less than 5% when metastases have been detected (Labianca et al., 2005; Hagggar et al., 2009).

The gold standard for early detection of colorectal cancer and its precursor lesions is the complete colonoscopy, a technique which has been proven to have the highest level of sensitivity and specificity for the detection of colorectal cancer and colorectal adenomatous polyps (Pox et al., 2013). According to common guidelines, screening colonoscopy in asymptomatic populations should start at the age of 55 (Pox et al., 2013). Timely screening aims to reduce the number of new cases of colorectal cancer, to have the disease diagnosed already at a stage with a

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more favorable prognosis, and to reduce the mortality rate associated with colorectal cancer (Pox et al., 2013).

Screening colonoscopy is the appropriate technique to achieve these objectives (Brenner et al., 2014). However, the participation rate in existing screening programs has proven to be rather low. Some studies have revealed that more than 80% of the patients concerned do not participate in screening programs (Pox et al., 2012). Already identified reasons for patients to refuse screening colonoscopy includes the lack of awareness, fear of pain and discomfort and worries concerning the possible results of the colonoscopy (Pox et al., 2012).

Advanced imaging techniques allow for a more precise evaluation of the intestinal mucosa and enhanced detection of colorectal lesions and within recent past multiple new devices have been introduced. The number of patients, however, who are informed about the offer and advantages of these methods, is rather small. Therefore, the aim of the present study was to evaluate, whether the offer of advanced imaging techniques may be an appropriate way to motivate patients to undergo colonoscopy.

## Materials and Methods

### *Patient selection, inclusion and exclusion criteria*

During the entire evaluation period a total of 372 patients participated in the study (168 females and 204 males). The study was approved by the Institutional Review Board (IRB) of the Friedrich-Alexander-University Erlangen-Nuremberg, Germany. Randomly chosen patients undergoing colonoscopy were included. Patients scheduled for other endoscopic examinations such as esophagogastroduodenoscopy (EGD) were not enrolled. Also isolated patients, patients in intensive care units (ICU), mentally retarded patients and non-German-speaking patients were not included. At first a pertinent standardized questionnaire was developed, in which patients could indicate how many of the advanced diagnostic methods were known, how much information they have about the technologies, and whether these methods were the decisive factor in their decision to undergo the endoscopic examination. This questionnaire was handed over to the patients when they presented themselves as inpatients or outpatients for the first time in our hospital in preparation for a screening colonoscopy. Patients were asked to comment on the following imaging techniques: Chromoendoscopy, endocytoscopy, endomicroscopy, CT-colonography, capsule endoscopy, magnification endoscopy, spectroscopy and balloon enteroscopy. Patient questioning started in October 2012. During the first five months no information campaign was launched in parallel with it. The next step was to provide potential patients, eligible for screening colonoscopy, with information about the new diagnostic methods, to draw their attention to the offer and to inform them about the advantages of these methods. For this purpose colorectal cancer screening campaigns were planned and performed from March 2013 until October 2013, which were intended to inform the patients inter alia through press, information events or internet about the importance of the screening for prevention of colorectal cancer, and about advanced

imaging techniques. Then in a second phase of the study, again randomly chosen patients were evaluated. In this phase information campaigns continued. Patients were again asked to fill in the standardized questionnaire and indicate how many of the above mentioned diagnostic methods were known to them and if the offer of advanced imaging techniques led them to undergo colonoscopy.

### *Statistics*

The statistical evaluation was started in October 2013. For this purpose the questionnaire results obtained in each month were compared with the baseline value (Baseline October 2012 - February 2013) and evaluated. The evaluation of the questionnaires was carried out in a completely anonymized manner. The t-test was used for all continuous variables to determine whether differences between any two groups existed. A two-sided P value <0.05 was considered to be significant. For comparisons of proportions we used the chi-squared test. If the validity of the chi-square test was in question, the Fisher exact test was used instead. Additionally, multivariate analysis was applied to determine, whether independent variables such as age or gender had a significant influence on the results.

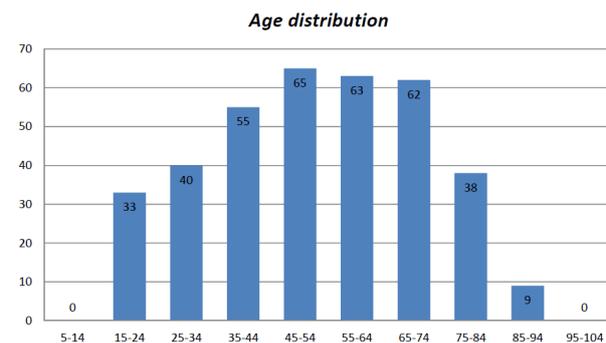
## Results

Overall, 372 patients filled in the questionnaire. Of these seven did not provide all the information asked in the questionnaire. 168 (45%) were females, and 204 (55%) males. The distribution by age in our study is given in Figure 1, from which can be seen that most of the patients belonged to the age group between 45 and 74 years (n=190).

In our study, 8% (n=29) of the patients had left school without qualification, 38% (n=142) had completed basic compulsory ninth-grade education with a qualifying final exam, 19% (n=71) had completed tenth-grade secondary education and 35% (n=130) had achieved the higher education entrance qualification. Of these, 29% (n=108) had studied at a university or college. Out of all patients questioned, 25% (n=89) came from the university town, 40% (n=141) from surrounding areas ( $\leq 30$  miles) and 35% (n=125) from more distant regions ( $>30$  miles distance).

### *Reason for the endoscopic examination*

Overall, 48% of the patients underwent colonoscopy (n=180) due to acute symptoms, such as blood in the stool, abdominal pain or diarrhea, 40% (n=150) due to chronic



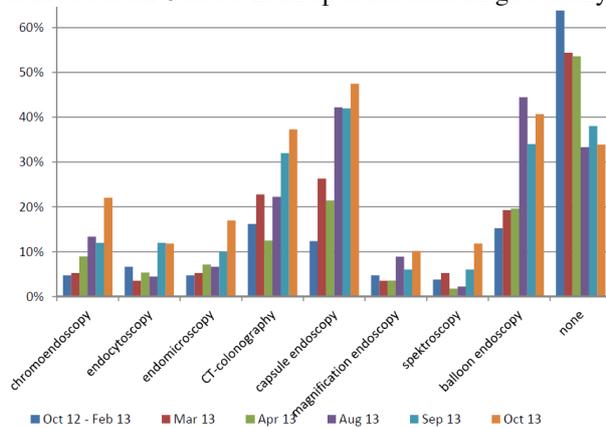
**Figure 1. Age Distribution of the Patients**

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problems and chronic bowel diseases such as Ulcerative colitis, Crohn’s disease or chronic diarrhea. 14% (n=53) indicated screening for the early detection of a possible colorectal cancer as reason, being 36% (n=19) of these females and 64% (n=34) males. Furthermore 49% (n=181) of the patients attended colonoscopy for the purpose of surveillance or follow-up care, due to the presence of a positive family history or previous finding of polyps, occurrence of colorectal cancer, chronic inflammatory bowel diseases or chronic diarrhea. In addition, 24% (n=90) of them mentioned different reasons for undergoing colonoscopy, as for example to be tested food intolerance or allergies. Because multiple mentions were possible the overall scoring rate was greater than 100%.

*Awareness of advanced imaging techniques among patients*

The above mentioned advanced imaging techniques were listed on the questionnaire. Figure 2 now reflects the survey results obtained in each individual month. The data collected from October 2012 up to and including February



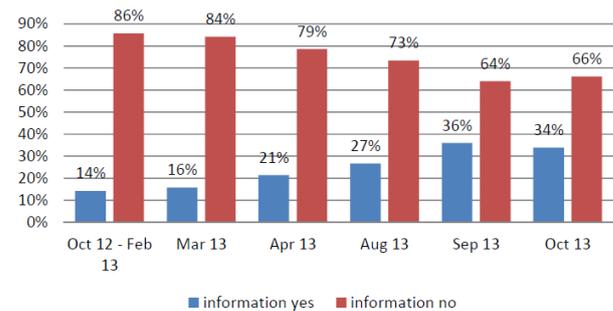
**Figure 2. Overview of the Rate of Patient Awareness of Advanced Imaging Techniques**

2013 are to be considered as baseline. During this period the patients had not yet been given additional information about advanced imaging techniques through media campaigns. The total percentage of patients indicating, that they had no information about any endoscopic imaging technique decreased from 64% at baseline to 34% ( $p \leq 0,001$ ) at the end of data collection.

For all mentioned techniques a significant increase in awareness could be observed. Diagnostic methods like CT-colonography, capsule endoscopy and balloon enteroscopy seem to be relatively well-known to patients already from the start. The data clearly reveal a continuous rise in the rate of awareness from month to month.

*Level of information*

During the first months of the survey period, in which no enhanced patient information through public campaigns were performed, 86% (n=90) of the patients stated that they were not informed about the respective imaging techniques. After starting the campaign in March 2013 a rise in the rate of patients feeling themselves informed was recorded (Figure 3). The overall level of information increased significantly from 14% at baseline to 34% after 12 months ( $p=0.005$ ).



**Figure 3. Rate of Patients Feeling Themselves Informed about Advanced Imaging Techniquis**

**Table 1. Changes in the Level of Information Observed over Several Months**

	Information yes	Information no	p-Values
October 2012 – February 2013	14.3%	85.7%	
March 13	15.8%	84.2%	0.82
Apr-13	21.4%	78.6%	0.27
Aug-13	26.7%	73.3%	0.10
Sep-13	36.0%	64.0%	0.003
October 13	33.9%	66.1%	0.005

**Table 2. Level of Information Results Obtained by Multivariate Regression Analysis**

Coefficients:	Estimated Coefficient	Standard Deviation	t-Value	p-Value
(Intercept)	5.08	0.44	11.5	0.00
Age	-0.01	0.01	-0.21	0.83
Early school leaving	-0.08	0.39	-0.19	0.84
Secondary education	-0.04	0.23	-0.16	0.87
University entrance level	0.23	0.19	1.13	0.26
Vicinity of screening clinic	0.06	0.22	0.26	0.79
Distance	-0.06	0.22	-0.28	0.78
Chronic bowel diseases	-0.45	0.19	-2.36	0.02
Female	0.21	0.17	1.27	0.20
Period March 13	-0.03	0.26	-0.11	0.90
Period April 13	-0.01	0.28	-0.03	0.97
Period August 13	-0.56	0.28	-2.01	0.04
Period September 13	-0.63	0.27	-2.34	0.02
Period October 13	-0.63	0.26	-2.42	0.02

The data covering the last two campaign months show a highly significant rise in the rate of patients feeling themselves informed about the presented advanced imaging techniques (Table 1). We could not find a significant difference between men and women in the level of information. Neither could it be proven by multivariate analysis that the level of education, age, socio-economic background, gender, chronic diseases, besides the time factor, had a significant influence on the level of information (Table 2).

The percentage of patients who decided to undergo colonoscopy because of the offer of new imaging methods also increased significantly from 12% at baseline to 42% after 12 months ( $p \leq 0,001$ ).

#### *Level of fear about the examination*

Fear about the examination is one of the most common reasons keeping patients from undergoing colonoscopy. Hereby a differentiation was made between "strong fear, moderate fear and without fear". Overall, the level of fear about colonoscopy stated by the patients from October 2012 until October 2013 was strong fear in 6% ( $n=22$ ), moderate fear in 31% ( $n=114$ ) and no fear at all in 63% ( $n=236$ ) of the patients. At baseline 43% of all patients indicated that they felt fear concerning the examination. This count decreased to 25% in October 2013 ( $p=0.031$ ).

## **Discussion**

The aim of the present study was to evaluate whether the offer of advanced imaging techniques may help to improve the acceptance rates to undergo screening colonoscopy. For this purpose various media campaigns providing information about the screening program and advanced imaging techniques were initiated. After some months, during which the patients had been imparted all relevant information, a remarkable rise in the patients' level of information about the new diagnostic methods could be recorded. Likewise, a significant increase could be shown in the rate of awareness of the different imaging techniques. Our results suggest that patients were highly interested in the offer of advanced imaging techniques. Knowledge about these techniques could relatively easy be provided by using local media campaigns. Therefore, the offer of advanced imaging techniques leads to higher acceptance rates for screening colonoscopies.

Although it could be proven that screening programs for colorectal cancer help to reduce incidence and mortality rates, only a small group of the patients is taking advantage of the offer to get screened for colorectal cancer (Stock et al., 2011; Camilloni et al., 2013). Also in our study the overall participation rate in screening colonoscopy was low with only 14% of patients participating. Since its introduction in Germany in October 2002 only about 18% of those eligible for screening colonoscopy made use of this offer. As of October 2002 a participation rate of 18.3% for men and 20.1% for women was recorded in the 55-74 year-old age group, while the highest participation rate was observed in patients aged between 60 and 69. Other studies have shown similarly low participation rates in screening programs for colorectal cancer. Stock et al. reported that

only 23% of male patients and 26% of female patients took advantage of screening colonoscopy (Stock et al., 2011). Pox et al. reported in their study a participation rate in screening colonoscopy of only 17.2% for women and 15.5% for men (Pox et al., 2012).

In our study it could be shown that the level of education has a significant influence on patient acceptance of screening colonoscopy. Among patients holding a university entrance qualification a markedly greater number of patients decide to undergo screening for colorectal cancer than patients holding compulsory school leaving certificate. This fact has also been confirmed in existing literature (Mielck et al., 1991).

One reason for the low participation rate in screening colonoscopy may be that people are scared about the examination. Of the patients questioned in our study only a small number indicated that they have strong fear of the examination. About one third indicated that they have moderate fear and two thirds that they have no fear at all of the colonoscopy. Many patients declared that a more precise description of what they feel would rather be a certain 'uneasiness' than genuine fear. An analysis of the data on the number of patients who do not fear the examination, obtained in each month of the evaluation period, shows that in October 2013 the number of patients who fear the examination was significantly lower than during the baseline-period. Therefore it can be expected that providing patients with enhanced information about colorectal cancer and new screening programs would help to reduce their fear. Patients often perceive invasive procedures such as colonoscopy as a procedure associated with fear, anxiety or pains. According to Morrison et al., these feelings can be generally defined as 'discomfort' (Morrison et al., 1998; Trevisani et al., 2014). In our study many patients stated that they have a feeling of 'uneasiness' about getting the procedure, which is comparable to discomfort, as described by Morrison. Also the role of modern sedation-protocols should be explained more in detail to our patients, as they provide the possibility to reduce pain and discomfort substantially (Kilgert et al., 2014).

Another reason why patients are reluctant to undergo screening for colorectal cancer is insufficient information and knowledge about the benefits, and the lack of physician recommendation to get screened for early detection of colorectal cancer and its precursor lesions. (Koo et al. 2012) have demonstrated that there is a clear relationship between the level of patient information and participation rate (Koo et al., 2012). Boguradzka et al. could show that the participation rate in screening for colorectal cancer was significantly higher in patients to whom adequate information was given by their physician, than in patients provided only with information contained in a leaflet (Boguradzka et al., 2014). This again clearly reveals that good quality information provided by the treating physicians can significantly help to increase the participation rate in colorectal cancer screening. The awareness towards modern strategies and advances in gastrointestinal endoscopy by the use of new endoscopic imaging techniques is important because these methods also play a crucial role in detection of early dysplastic

*The Offer of Advanced Imaging Techniques Leads to Higher Acceptance Rates for Screening Colonoscopy - a Prospective Study* lesions (Neumann et al., 2014).

At the beginning of the study only a very small number of patients answered affirmative to the question whether the offer of new methods had been the decisive reason for having the examination, whereas after thorough information imparted over many months finally almost half of the patients did so. Such a remarkable increase gives reason to assume that the acceptance rate of colorectal cancer screening can indeed be increased by offering the advanced imaging techniques. As a result of the information campaigns a distinct rise in the participation rate for men and women could be observed, compared to the baseline value. Groth et al. also have shown that a higher participation rate could be achieved by capsule endoscopy (Groth et al., 2012). de Wijkerslooth et al. have shown that offering CT-colonography has also proven to be an effective means of raising the participation rate (de Wijkerslooth et al., 2012). In the course of our study an enormous improvement in the awareness of all mentioned imaging techniques among patients could be observed. Apart from the level of awareness of the new methods, an improvement through the information campaigns could also be observed in the level of information among patients about these methods. As a result of the campaigns a significant increase in the number of informed patients could be recorded, as well as a rapid increase in the level of information about advanced imaging techniques, compared to the baseline-period. It can be stated that patients show great interest in the offer of advanced imaging techniques. There was also a significant increase in the number of patients stating that it was precisely because of the new methods that they decided to undergo colonoscopy. Due to the broad range of advanced endoscopic imaging techniques patients and physicians should be continuously kept informed about the new methods. Especially as advanced endoscopic imaging techniques have been shown to improve adenoma detection rates (Neumann et al., 2015). It is therefore recommended that the population continues to be regularly informed about ongoing campaigns. The objective should be well organized programs for the early detection of colorectal cancer, invitations addressed to all patients, eligible according to their age, to participate in the programs, and information brochures on advanced imaging techniques. The patients reacted very positively towards diagnostic methods offered to them as alternatives to standard colonoscopy. Their acceptance and willingness to undergo screening colonoscopy could be increased by offering them a wide variety of methods.

Potential limitations of our study should also be acknowledged. The probability of selection bias due to the design of the study should be considered as randomly chosen patients were included. But this bias seems to be tolerable in the given context as also patients undergoing the examination for other reasons than screening can profit from the examination in this effect. E.g. chronic diarrhea or blood in the stool can also be symptoms of cancer and thus looking for a reason for these symptoms always means screening for malignancy.

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